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NORTH CAROLINA
DEPARTMENT OF CONSERVATION AND DEVELOPMENT
R. BRUCE ETHERIDGE, DIRECTOR

DIVISION OF MINERAL RESOURCES
JASPER L. STUCKEY, STATE GEOLOGIST

BULLETIN NUMBER 54

MARLS AND LIMESTONES OF EASTERN NORTH CAROLINA

BY
E. WILLARD BERRY

RALEIGH
1947

North Carolina
Department of Conservation and Development
R. Bruce Etheridge, *Director*

Division of Mineral Resources
Jasper L. Stuckey, *State Geologist*

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OF
Eastern North Carolina

By
E. Willard Berry

Raleigh
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LETTER OF TRANSMITTAL

Raleigh, North Carolina
February 2, 1948

To His Excellency, HON. R. GREGG CHERRY,
Governor of North Carolina.

SIR:

I have the honor to submit herewith, as Bulletin 54, a report entitled "Marls and Limestones of Eastern North Carolina," by E. Willard Berry.

Marls and limestones are important mineral resources in which there is an increasing interest. This report indicates that there are two areas in Eastern North Carolina which contain important reserves of these materials. It is hoped that the information presented may prove helpful in the development of these natural resources.

Respectfully submitted,

R. BRUCE ETHERIDGE,
Director.

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MARLS AND LIMESTONES OF EASTERN NORTH CAROLINA

By: E. W. BERRY*

INTRODUCTION

In 1918 the State of North Carolina, in cooperation with the United States Geological Survey, conducted a survey of the limestones and marls of North Carolina. This was published in 1921 as Bulletin No. 28 of the North Carolina Geological and Economic Survey. This Bulletin, which covered the limestones and marbles of the western part of the State and the limestones and marls of the Coastal Plain, is now out of print. Due to the interest in the limestones and marls of the Coastal Plain, it was thought desirable to check over the activities in that area. This is a preliminary report as it has been impossible to visit all the reported and abandoned pits in the area. It is hoped that this can be done eventually.

The author wishes to express his thanks to the various County Agents and the Chambers of Commerce who have kindly answered inquiries about marl pits in their respective areas. He also wishes to thank Dr. Jasper L. Stuckey, State Geologist, and Mr. Paul Kelly who have made this work possible.

GEOLOGIC SECTION OF THE COASTAL PLAIN OF NORTH CAROLINA

The section encountered in the Coastal Plain of North Carolina ranges from the Tuscaloosa of the upper Cretaceous through the thin veneer of Pleistocene.

The section recognized in 1921[1] is as follows:

Cenezoic

Quarternary

Pleistocene	Pamlico, Chowan, Wicomico, Sunderland, Coharie	Columbia Group

Tertiary

Pliocene	"Lafayette", Waccamaw	
Miocene	Yorktown, St. Mary's	North of Neuse River: Duplin Marl; South of Neuse River
Eocene	Castle Hayne, Trent Marl	

Mesozoic

Cretaceous

Upper Cretaceous	Pee Dee, Black Creek
Lower Cretaceous	Patuxent formation

[1] Loughlin, G. F., Berry, E. W., and Cushman, J. A., Limestones and Marls of North Carolina. North Carolina Geol. and Econ. Survey Bull. 28, p. 83, 1921.

* E. W. Berry, Professor of Geology, Duke University, Durham, N. C. Associate Geologist, Dept. Conservation and Development, Raleigh, N. C.

In the light of studies during the past several decades, the following section is proposed:

Cenzoic

Quarternary

Pleistocene	Pamlico Chowan Wicomico Sunderland Coharie Lafayette	Columbia Group

Tertiary

Pliocene	Waccamaw and Croatan sand
Upper Miocene	Yorktown including Duplin Marl
Lower Miocene	Trent Marl
Upper Eocene	Castle Hayne (Jackson)

Mesozoic

Upper Cretaceous	Pee Dee Black Creek Tuscaloosa

MARL AND LIMESTONE BEARING FORMATIONS

The following formations contain marls and limestones: Pee Dee formation, Castle Hayne limestone, Trent marl, Yorktown formation, Waccamaw formation, Chowan and Pamlico formations. The others in general are only sparingly fossiliferous and not lime bearing.

CRETACEOUS MARLS

(Upper Cretaceous)

The Pee Dee formation is a gray to dark gray argillaceous, micaceous sand, carrying in places thin beds of limey concretions. It often contains more or less pyrite and sometimes lignitic tree remains. From available reports[2] the amount of calcium carbonate seldom exceeds 30 per cent while the silica runs from about 40 per cent to as high as 90 per cent. The Pee Dee sand was used as a commercial fertilizer filler for many years by the Acme Fertilizer Company at the town of Acme but this practice was discontinued some years ago. It was used for its sand content alone. At the present time there is no Pee Dee being used, and it is questionable if it is worth anything from the point of view of its calcium carbonate content.

EOCENE MARLS

The Castle Hayne limestone is the only formation of Eocene age now recognized in North Carolina. It is upper Eocene and can be correlated with the Jackson. The Castle Hayne is a series of marls, limestones, sands, and a few clays. The basal portions often contain phosphatic pebbles. In some places the upper portion is soft and easily worked (though the author is not certain whether this soft part is Castle Hayne or a younger marl (Trent) on top of the Castle Hayne). There is at present no commercial production from the Castle Hayne for marl, but it is being used for mineral aggregate. Interest is being shown by Mr. Hugh MacRae at his farm at Rocky Point, Pender County, where it was ground and used some twenty years ago. Here the calcium carbonate ranges up to 88 per cent.[3]

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[2] Lc p. 90.
[3] Personal communication by Mr. H. MacRae.

MIOCENE MARLS

The marls of the Miocene occur in the Trent and Yorktown formations. The Trent is lower Miocone in age rather than Eocene.[4]

It receives its name from the exposures along the Trent River from Trenton to New Bern. The Trent marls are in places composed of entire shells while in other places only shell fragments are to be found. The fossils where present are oysters, bryozoa, sea urchins and sand dollars, with occasional brachipods (terabratula forms). In places there is more or less solution and silicification making an open stone suitable for buhrstones or mill stones. The walls and gate pillars of the cemetery at New Bern are of this silicified open Trent. (It is the author's opinion that the soft marl from H. MacRae's plantation is a pocket of soft Trent on top of harder Castle Hayne.)

The upper surface of the marl is often very irregular due to deep and often narrow solution pits. The marl has been used for road metal, agricultural lime, and at present (1946) a company in New Bern is planning to make steam cured building blocks out of it calling them "Marlcrete". There is talk of using it for cement but here the question of the high silica content must be settled. It is the only marl now being worked, as far as the author knows, except the Castle Hayne at Belgrade.

The Yorktown formation includes here the St. Mary's and Duplin of the older reports. They are all of the same or about the same age and probably represent facies of the Yorktown. The author is convinced from field evidence that the typical Yorktown extends well south of the Neuse River. The Yorktown does not contain nearly as high amount of lime as the Trent which may run up to 90 per cent. It is usually a shell marl with a high per cent of sand or clay. It should be noted that the sandy shell marl is not good on sandy land but is satisfactory for clay land, and the clayey shell marl is suitable for sandy land. The Yorktown (Duplin) is worked sporadically at Natural Wells in Duplin County for use on the land but no great quantity has been removed.

PLIOCENE MARL

The Pliocene contains the Waccamaw formation in the Cape Fear region and the Croatan sand in the northeast. Only the Waccamaw contains marls. The marl is almost entirely of the shell variety; although there are occasional indurated lenses which might be called poor limestone. The marl occurs as lenses in a predominantly sandy formation. In most cases the lenses are small but rich in lime running as high as 95 per cent calcium carbonate in places. It outcrops near Supply in Brunswick County and has been dug for chicken lime near Kelly in Bladen County. Further investigation may disclose workable deposits. It is not being worked at present.

PLEISTOCENE MARLS

The Chowan and Pamlico are the only Pleistocene formations containing enough shells to be called marls. The marl lenses are scattered and of limited extent, and often are not exposed by natural erosion as the country they cover is very flat and level. They are occasionally exposed by drainage ditches and, if not below, may be at or near tide level. In general, the marls are about half sand or clay and, hence, rather low grade. In places they are in the form of a coquina rock as in southern New Hanover County where they have been used as road metal in the past. Large pits near Belhaven show these shell marls on the spoil piles, but there is no record of the marl having been used.

USES OF MARLS AND LIMESTONES OF EASTERN NORTH CAROLINA

The soft marls low in sand can be used as a land dressing and the harder marls can be ground and used the same way. The low sand marls should be applied to sandy lands. The high sand, poorer lime, marls would benefit the heavy clay and black lands. The high lime, low sand, marls are also a possible source of lime for cement. There was a cement plant underway at the time of the 1929 depression, but the business failure was not due to the character of the marl and limestone.

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[4] Kellum, L. B., Paleontology and Stratigraphy of the Castle Hayne and Trent marls in North Carolina. U. S. Geol. Sur. Prof. Paper 143, 1928.

The hard marl and limestone has been used in large quantities for roads and airstrips in Government areas during World War II. It has also been used as mineral aggregate in concrete both for buildings and roads. Some is now being used in cement blocks. It has been suggested that it can be used to make steam-cured lime bricks as is done with the Ocala limestone in Florida. Some is now being used for road metal both for private and public roads.

DESCRIPTION OF IMPORTANT AREAS

There are thirty-five counties in the coastal plain portions of the State which may have usable marls. However, in the areas around New Bern and north of Wilmington the marls are higher grade and more persistent than in the rest of the coastal plain—hence, these two areas will be considered separately as units as well as by counties.

THE NEW BERN AREA

This area is taken to include parts of Craven, Jones and Onslow Counties. The principal places where the marls are exposed are along (1) White Oak River from 1½ miles above Belgrade to Hunting Creek; along (2) the Trent River from Pollocksville almost to James City; and along (3) the Neuse River east of Fort Barnwell to the Bridge at Streets Ferry.

Along the White Oak River, beginning 1½ miles up river from Belgrade and extending down stream to Hunting Creek (also near Stella and Kuhns, Carteret County) marl is present but not everywhere exposed. The marl up river from Hunting Creek appears to be the Trent marl (lower Miocene) whereas that around Stella and Kuhns is Yorktown marl (Duplin facies, upper Miocene). The Yorktown marl here is of minor importance as it is rather clayey and low in lime but has been used in the past for liming land. The most important locality along the White Oak River is at Belgrade. Some 8½ to 12 million tons of limestone were dug here during World War II. After removing about 10 feet of sandy overburden a 24 foot layer of the limestone was quarried. Just how thick this limestone is here is unknown but 8½ miles north of Belgrade, at the U. S. Marine Corps Auxiliary Air Base (3 miles west of Pollocksville, Jones County), there are 15 feet of yellow sandy Trent marl under 20 feet of Pleistocene sand, and 163 feet of Castle Hayne marl under 57 feet of cover.[5] This raises the question as to the age of the limestone exposed at Belgrade where it is suggested that two formations may be present.[6]

Earlier writers considered the possibility of Duplin on top of Castle Hayne. The author is of the opinion that the Trent (lower Miocene) lies unconformably on the Castle Hayne (upper Eocene). This would explain the softer upper layer and its irregular occurrence as one goes down stream from Belgrade and also the Castle Hayne character of the hard limestone. At any rate, it seems to the author that we have here a great thickness of limestone, possibly over 150 feet. However, water is a problem as some three million gallons of water a day must be pumped to keep the quarry dry enough to excavate a 24 foot layer. As one goes down river the limestone looks more like the typical Trent but outcrops are not abundant enough or sufficiently well exposed to definitely establish the exact age of the limestones.

If we extend the straight north-south boundary of Craven County south to Hunting Creek and north to the Neuse River and then strike a line parallel to the boundary, but 10 miles farther west between White Oak and the Neuse River, with these 2 rivers as north and south boundaries, an area of about 250 square miles or 160,000 acres will be enclosed, which is probably underlain by limestone or marl.

The Trent marl is exposed along the Trent River from the bridge above Trenton, where 5 feet are exposed, to within 4 miles of New Bern, where some 3 feet are exposed above high tide. The Trent is highest above water level between Pollocksville (Castle Hayne is exposed at Pollocksville) and just below Island Creek. It reaches its highest point on the Hardy Whitford property where some 20 feet are exposed above water level on the south bank of the river. The north bank has been extensively worked east of Pollocksville to Wilson Creek where numerous old quarries can be seen. One of these, the Simmons, is still being worked. Here the marl is soft and can be easily excavated.

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[5] Mundorff, M. J., Selected Well Logs in the Coastal Plain of North Carolina, North Carolina Dept. Cons. and Devel., Div. Min. Res. Inf. Circ. 3, p. 26, 1945.
[6] Kellum, L. B., Paleontology and Stratigraphy of the Castle Hayne and Trent marls in North Carolina. U. S. Geol. Sur. Prof. Paper 143, p. 125, 1928.

Along the Neuse River from about the Craven County line to Streets Ferry Bridge there are numerous exposures of marl, mostly Trent in age but a few exposures of Yorktown are present. A few of these are fairly thick (up to 21 feet) but usually only about 8 to 10 feet lie above the water table. These marls are mostly sandy and, hence, high in silica. New Bern's test well shows 50 feet of Trent limestone under an overburden of 40 feet, with Castle Hayne marl (very sandy here) immediately below the Trent.[7]

The Trent marl is in general moderately hard and contains numerous fossil remains, often in the form of casts and impressions although in places oysters, bryozoa and sand dollars are common. The marl is usually somewhat porous and open. The upper surface is very irregular due to solution channels and in places it is iron stained and/or silicified.

The Castle Hayne is usually less porous than the Trent and harder and more compact. The fossils are poorly preserved.

Analysis: (See table.)

TABLE I
MARL AND LIMESTONE ANALYSES

LOCALITY	Horizon	$CaCO_3$	SiO_2	P_2O_5	Fe_2O_3	Al_2O_3	$MgCO_3$	Reference
Rock Landing, Neuse	Trent	66.29						*
Rock Landing, Neuse	Yorktown	51.62	48	0.18				*
Belgrade 1	Trent	56.50		4.3				*
Belgrade 2	Castle Hayne	37.62		8.0				*
Trent River	Trent	91.96	3.86		0.58	1.00	2.20	+
Near River	Trent	95.18	3.65		0.65	0.30	0.64	+
One mile back	Trent	95.52	1.48		0.40	1.13	0.37	+
Trent River M. & L. Co.	Trent	85-93						*
Trent River M. & L. Co.	Trent	85.22		0.33				*
N. C. Department of Agriculture	Trent	87.72		0.15				*
N C. Department of Agriculture (ground)	Trent	85						*
John Whitford Prop	Trent	72.19	26.05					*
Whitford Landing	Trent	78.32		0.49				*
Trenton	Trent	34.00						*
	Trent	44.00						*
	Trent	79.00						*
Scotts Landing	Trent	85-93						*
Chemical Lime Co.	Trent	94.58	4.09					*
Chemical Lime Co.	Trent	89.80	3.74					*
Average 13 analyses	Trent	79.22 to 94.93						*

THE WILMINGTON AREA

This area includes parts of New Hanover and Pender Counties. Here the Castle Hayne (Eocene) limestone is the chief source of lime. The Castle Hayne has a much greater extent than this area, as it is exposed on the Trent River at Pollocksville, and on the Neuse around Biddles Landing and Maple Cypress in Craven County. Castle Hayne marl was worked during 1945 by the Superior Stone Company of Raleigh

[7] Mundorff, M J, Selected Well Logs in the Coastal Plain of North Carolina, North Carolina Dept. Cons. and Devel., Div. Mln. Res. Inf. Circ. 3, p. 19, 1945.
* Lc pp 111-123.
† Economic Paper 62, N. C. Dept. Conservation & Development, The Mining Industry in N. C. in 1928 pp. 53-54.

4 miles south of Warsaw, Duplin County. The pits of the company are about 3 or 4 miles from the railroad. When these pits were last visited (1946) they were shut down and the pumps were not running, but electric power was still connected. The Castle Hayne has the greatest areal extent of any of our Coastal Plain marls and has been worked at many places in the past.

The deposits are somewhat irregular and the operators apparently had difficulty in following their extent as there were numerous trenches in many directions. The extent of the deposits has not been determined. This area is about 60 miles from Wilmington.

The old Castle Hayne quarries at Castle Hayne, New Hanover County, showed 1 to 10 feet of hard limestone. They are now full of water and abandoned. The City of Wilmington Quarry on Smith Creek shows 9 to 11 feet of limestone and is still being worked for road metal. From these two quarries northward, the Castle Hayne is fairly common. At Mr. Hugh MacRae's plantation, east of the town of Rocky Point, there is a considerable area so near the surface that limestone is struck by the plow and is exposed in ditches. Here it is reported to be over 20 feet thick but no proof of this thickness is available. Some limestone was ground here in 1918, and in 1945 the crusher was still in place but had not operated for many years. Between Rocky Point and Castle Hayne there is much "black land" which could well stand liming with ground Castle Hayne. The Castle Hayne is found along the Northeast Cape Fear River from Smith Creek to within about 10 miles of the north boundary of Pender County but, as the area is low, only a small layer is above the water table. The area is poorly served by roads for the same reason. There seems no reason though, why some higher areas in this locality could not produce limestone suitable for liming the land.

DESCRIPTION BY COUNTIES

BEAUFORT COUNTY

The eastern part of the county is a low plain of the Pamlico formation and should contain small, scattered, poor-grade deposits of Pamlico shell marls which are probably too poor to consider as they contain only about 50 per cent calcium carbonate; some near Belhaven are reported to run up to nearly 55 per cent. These should help condition the heavy soils in that area.

The western part of the county is higher and, although the surface has thin surficial deposits of Pleistocene sands and loams, it is underlain by deposits of Yorktown Miocene with local marls such as have been dug around Washington and Chocowinity. Here some of the marls run from 56 to 81 per cent calcium carbonate, but the average is around 60 per cent.

The Styron Plant mentioned in Bulletin 28 has been out of operation for years.

At the present time there are no marl pits operating and none have been operating for many years.

Analysis:[8]

Yorktown marl:

Washington and Chocowinity 56-81% calcium carbonate, trace phosphate, average 60% calcium carbonate.

Pleistocene marl:

J. J. Barnet, Belhaven. 49.58 and 54.55 per cent calcium carbonate.

(N. C. Department of Agriculture)

BERTIE COUNTY

Bertie County is underlain with deposits of Yorktown Miocene and largely covered with Pleistocene sands and loams. Pleistocene Pamlico shells occur north of the road from Edenton to Windsor just west of the Chowan River bridge and below the road level. Here the sands contain only a few shells and can hardly be called a marl.

[8] Loughlin, G. F., Berry, E. W., and Cushman, J. A., Limestones and Marls of North Carolina. North Carolina Geol. and Econ. Survey Bull. 28, p. 105, 1921.

The Yorktown Miocene contains shell marls and these have been used on land in the past. The deposits are usually buried quite deep. Drilling at Windsor reports "shell rock fourteen feet at a depth of eighty-two feet," and at Colerain, "sand, and fine shell fourteen feet at 232 feet."[9] Where these Yorktown marls are exposed at or near the surface they might well be used for liming land if they have enough lime. They range from 28 to 63 per cent calcium carbonate averaging about 50 per cent.[10]

BLADEN COUNTY

Bladen County is entirely covered with surficial Pleistocene sands and loams, in most cases directly underlain by Black Creek Cretaceous. There are occasional patches or lenses of Yorktown Miocene and Waccamaw Pliocene between the Cretaceous and the Pleistocene south of the Cape Fear River. These have been worked from time to time but today are abandoned. Waccamaw marl was being dug in 1938 along the road north of Carvers but ony a few hundred pounds at a time were being taken for chicken feed. Waccamaw marls were dug years ago around Rosendale and Council.

The Waccamaw marl may be excellent but usually is of very limited extent and very variable in composition. The Miocene marls are also limited and quite variable.

Analysis:[11]

Waccamaw marl runs 48 to 94 per cent calcium carbonate.

Yorktown marl, "Oyster Shell Ridge" 70 per cent calcium carbonate. (p. 135)

Average run 44 to 94 per cent.

BRUNSWICK COUNTY

The surface of Brunswick County is the younger Pleistocene. In the northern part this is underlain by Pee Dee Cretaceous and in the southern part by Waccamaw Pliocene on top of Cretaceous. The author saw no evidence of Yorktown (Duplin) Miocene or Castle Hayne Eocene in the area. Waccamaw marl may occur along the Cape Fear, and it has been worked in recent years about Winnabow. Marls are reported along Town Creeek but they are not of recognizable age. Exposures of Waccamaw marl occur in the region just east of Supply and south of Route 17. These are small but have occasionally yielded a few hundred pounds for chicken feed.

The use of marl has stopped due to cheaper ground limestone shipped in.

Analysis:

Yorktown-Brunswick River 87.57 per cent calcium carbonate.[12]

CAMDEN COUNTY

Camden County is a near sea-level plain made up of the Pamlico formation with some recent dunes rising above the plain. Local lenticular shell beds have been found in excavations and ditches but in every case they have all been small and fairly low in lime. Similar beds should occur scattered anywhere in the county but, because of their small size and low lime content, would not be of commercial value.

The Camden Causeway from Elizabeth City to Camden was built by dredging up a fill, in which Pamlico shells were found.

CARTERET COUNTY

Carteret County is generally a low plain covered with Pamlico formation. Scattered low-grade shell marls occur in the county but are too low-grade for use. Marl has been taken from old pits between Stella and Kuhns which is probably of Yorktown age. This marl was used on the land but how much and with what success is unknown. Some Yorktown marls were dredged up along the 12-foot channel of the Intercoastal Waterway west of Bogue but they were low in lime. Shell marl is reported near Newport and along the White Oak River but these seemly are of poor grade.

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[9] Mundorff, M. J., Selected Well Logs in the Coastal Plain of North Carolina, North Carolina Dept. Cons. and Devel., Div. Min. Res. Inf. Circ. 3, p. 9, 1945.
[10] Loughlin, G. F., Berry, E. W., and Cushman, J. A., Limestones and Marls of North Carolina. North Carolina Geol. and Econ. Survey Bull. 28, p. 101, 1921.
[11] Lc. p. 128.
[12] Lc. p. 134.

A well drilled at Marine Corps Auxiliary Air Base, altitude 15 feet, at Atlantic, penetrated Pliocene Croatan sand with shells at 30 to 90 feet, and Duplin below that.[13] A well on U. S. Navy Section Base, Morehead City, altitude 23 feet, cut Croatan sand with shell at 30 feet and Yorktown sandy limestone at 97 feet.[14] A well at Fort Macon State Park, elevation about 10 feet, encountered shelly sand (Pamlico?) at 50 feet and sandy limestone at 80 feet. A well at U. S. Marine Auxiliary Air Base, Bogue, altitude 18.5 feet, encountered shells from 40 feet down with Miocene limestone at about 105 feet and Trent limestone at 175-260 feet. These deep marls, although interesting, are too deep to be of value. The marl around Stella and Kuhns has not been worked for about 25 or 30 years and is probably of little value.

CHOWAN COUNTY

Chowan County is largely covered with Pleistocene sands and loams. Under these the Yorktown formations contain some poor shell marls. A well drilled at Edenton[15] encountered the Yorktown at the depth of 50 feet and shell marls at about 105 feet. A well at Marine Corps Air Station, 4 miles southeast Edenton, encountered the Yorktown at 60 feet and shells at about the same depth. This would indicate that these poor grade marls are too deep to consider.

COLUMBUS COUNTY

The Wicomico and Chowan Pleistocene terraces cover all of Columbus County but are usually quite thin. Beneath this Pleistocene cover and in depressions on top of the Cretaceous are scattered lenses of Yorktown (Duplin) Miocene and Waccamaw Pliocene. These may be found at most places in the county, but they are small in area, often quite thin, and are not of sufficiently good grade to warrant operation.

The fertilizer plant at Acme had a thin bed of Waccamaw Pliocene in its pit but did not use it even though it ran up to 95 per cent calcium carbonate. This marl is only a few inches thick. The pit was for sand filler.

Marls at Neills Eddy landing contain from 65 to 85 per cent calcium carbonate.

Analysis:[16]

Waccamaw marls 77.96 per cent calcium carbonate with 0.46 per cent phosphoric acid.

CRAVEN COUNTY

Craven County has surface deposits of sand, loam, and peat of Pleistocene to recent age. The eastern part is about at sea level, and it rises gradually to the west and north to about 60 feet. In the western part, under the Pleistocene, is Trent Miocene and in the eastern part is Castle Hayne Eocene.

Marl has been dug in the area between Riverdale and Croatan. At Riverdale it was underlain by an oyster shell bed[17] along Slocum Creek, at Shell Slough on the Neuse. Exposures occur on the banks of the Neuse behind the first school south of James City and east of U. S. Route 70. These marls are all Pleistocene and, although spotty and often quite variable in amount of lime, might be of local use.

The marl pit off the road between Maple Cypress and Hanrahan, mentioned in Bulletin 28, p. 109, has not been worked in many years although there is considerable marl of varying hardness lying around the pit. Marl is irregularly exposed along the southwest bank of the Neuse River from just east of Fort Barnwell to the Bridge at Streets Ferry. These marls are all more or less sandy and are either Trent, Castle Hayne, or Yorktown Miocene.

In 1912 The Chemical Lime Company of New Bern had a plant on the north bank of the Trent River at the mouth of Wilson Creek where they made hydrated lime and later just ground marl. It shut down in April 1912. The pits showed marls averaging 90 per cent calcium carbonate with an average thickness of 21 feet.[18]

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[13] Mundorff, M. J., Selected Well Logs in the Coastal Plain of North Carolina, North Carolina Dept. Cons. and Devel., Div. Min. Res. Inf. Circ. 3, p. 24-25, 1945.
[14] Lc. p. 24.
[15] Lc. p. 10.
[16] Loughlin, G. F., Berry, E. W., and Cushman, J. A., Limestones and Marls of North Carolina. North Carolina Geol. and Econ. Survey Bull. 28, p. 137, 1921.
[17] Lc. p. 108.
[18] Lc. p. 112-144.

At the present time (1946) pits which have been operated in the last several years are near Fort Barnwell, Epworth, Wintergreen, Jasper and Core Creek.

Analysis:[19]

Yorktown; Rock Landing, Neuse River	51.62 per cent calcium carbonate
	0.18 phosphate (P_2O_5) and 48 per cent silica (SiO_2)
Trent; Rock Landing, Neuse River	66.29% $CaCO_3$
Chemical Lime Company, New Bern	Calcium Carbonate Silica
	94.58 4.09
	89.80 3.74
Average 13 analysis	79.22 to 94.93 per cent

CURRITUCK COUNTY

Currituck County is a near sea-level plain made up of the Pamlico formation with some recent sand dunes on the plain. Local shell beds have been found in ditches and excavations in the north end of the county. Local beds of the same kind of shell marl may be found scattered in the county. However, the beds are small, poor in lime, and definitely not of any commercial importance.

DARE COUNTY

Dare County is a low plain of the Pamlico formation and should have local deposits of Pamlico shell marl. As the Pamlico shell marls are universally poor grade and limited in extent elsewhere, they are probably of little importance here.

DUPLIN COUNTY

Pleistocene terrace materials make up the entire surface of Duplin County. The northwestern part of the county is underlain by Black Creek Upper Cretaceous and the rest of the county by Pee Dee Upper Cretaceous. Between the Pleistocene and the Cretaceous are disconnected lenses and remnants of Castle Hayne Eocene, Yorktown (Duplin) and Trent Miocene. These last three contain the only marls and/or limestone in the region.

The Trent marls extend more or less easterly from around Kenansville to the Jones and Onslow county lines. West of Kenansville the Yorktown (Duplin) Miocene occurs in a more or less north-south belt, while south of the Trent and east of the Yorktown is the Castle Hayne.

The oldest working for marl in the county is at Natural Wells a few miles west of Magnolia where there are several sinks which show both Yorktown (Duplin) and probably Trent marls. This is the classic Duplin locality. Marl in small quantities has been taken from this pit for years but no great amount has been used in recent years. The overburden is from 10 to 15 feet thick.

On the farm of Mr. H. D. Williams between Serecta and Pine Hill (Lenoir County) about six miles from Pink Hill considerable marl was dug, up to about 1942 to 1943. The marl is probably Trent Miocene.

The Superior Stone Company of Raleigh operated a marl pit on the farm of E. R. Carlton, 4 miles south of Warsaw, during 1945. Here they had extensive openings and trenches. They ground and screened the marl and trucked it from the pits. In the fall of 1945 they were not operating these pits. The marl contained many Bryozoa and Echinoids and is probably Castle Hayne in age. This marl apparently is a good one and should be valuable both as a source of lime, and the harder parts for aggregate in concrete.

The Yorktown marls are very variable in calcium content; records show that they run from 30 to 90 per cent calcium carbonate (Bull. 28, p. 124) and offer little hope of commercial deposits.

The Castle Hayne is not being worked as far as is known at present; although it was reportedly used in 1918 near Chinquapin[20] where it was reported 72.24 per cent calcium carbonate and 2.74 per cent phosphoric acid.

Analysis:[21]

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[19] Lc. p. 111-112.
[20] Lc. p. 123.
[21] Lc. p. 123-124.

Castle Hayne
Chinquapin ..... 72.24% calcium carbonate 2.74 phosphoric acid
Yorktown
Warsaw ..... 31.07% calcium carbonate
86. % calcium carbonate
Rose Hill ..... 90.74% calcium carbonate

EDGECOMBE COUNTY

Edgecombe County is generally flat and the surface is made up of sands and loams of the Pleistocene. Below these surficial beds are scattered beds of Yorktown Miocene on older upper Cretaceous. It is about 75 years since any marl has been dug in this county and the reports of marl pits have disappeared with the passing of time. The Pleistocene seems to be without marls and the Yorktown has rather limited and low grade marls. These Yorktown beds outcrop down the Tar River from Rocky Mount to the county line and on the creeks near Wrendale and Battleboro. A well at Pinetops[22] penetrated Yorktown marl at 57 feet.

Analysis:[23]

Yorktown ..... Under 25% calcium carbonate

GATES COUNTY

Gates County, although largely covered with Pleistocene sands and loams, is higher and less swampy than the counties to the east. The county is underlain by the Yorktown formation which outcrops along the Chowan River. The Yorktown contains some poor grade shell marls which are of little value due to the low content of lime.

GREENE COUNTY

Greene County ranges in elevation from 30 to 120 feet above sea level. The surface is covered with thin beds of Pleistocene sands and loams underlain with Cretaceous except where occasional lenses of the Yorktown Miocene intervene. These scattered shell marls are generally low in lime and have not been worked. Yorktown beds with fossils are known but these do not contain even 25 per cent calcium carbonate.

Analysis:[24]

Yorktown ..... Less 25% calcium carbonate 0-3% silica

HALIFAX COUNTY

Halifax County is underlain on the western half by older crystalline rocks devoid of lime. The eastern half is underlain with scattered deposits of the Yorktown Miocene largely hidden by Pleistocene sands and loams. Where the Yorktown is exposed and contains marl it has been dug locally at numerous localities along the rivers, streams, and along the Atlantic Coast Line Railroad near Scotland Neck. The calcium carbonate ranges from about 35 to 85 per cent generally running under 50 per cent. Additional exploration might show some of these marls suitable for liming land. A well at Scotland Neck, altitude about 100 feet, records 12 feet of Yorktown marl at a depth of 41 feet.[25]

Analysis:[26]

Yorktown marl
Scotland Neck ..... 36% calcium carbonate
Tillery ..... 87% calcium carbonate

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[22] Mundorff, M. J., Selected Well Logs in the Coastal Plain of North Carolina, North Carolina Dept. Cons. and Devel., Div. Min. Res. Inf. Circ. 3, p. 19, 1945.
[23] Loughlin, G. F., Berry, E. W., and Cushman, J. A., Limestones and Marls of North Carolina. North Carolina Geol. and Econ. Survey Bull. 28, p. 102, 1921.
[24] Lc. p. 105.
[25] Mundorff, M. J., Selected Well Logs in the Coastal Plain of North Carolina, North Carolina Dept. Cons. and Devel., Div. Min. Res. Inf. Circ. 3, p. 8, 1945.
[26] Loughlin, G. F., Berry, E. W., and Cushman, J. A., Limestones and Marls of North Carolina. North Carolina Geol. and Econ. Survey Bull. 28, p. 100, 1921.

HERTFORD COUNTY

Hertford County ranges in elevation from east to west from near sea level up to 70 to 80 feet. The Cretaceous here is buried at depths of from 140 feet to 250 feet and carries on its upper surface scattered remnants of the Miocene Yorktown formation. The whole area is thinly covered over with Pleistocene sands and loam. The Yorktown is poorly exposed along the Meherrin River, the Wiccacon River and Potecasi Creek. In the past, marl has been dug near Lotta, Murfreesboro, and Winton; but no digging has been done, as far as is known, in the last five years.

Reports of the marl from Potecasi Creek give as high as 78 per cent calcium carbonate, but average samples run under 50 per cent. It is possible that these marls along Potecasi Creek might, if in large enough quantities, be used for liming land. These could be used on peanut lands with benefit. The others are, on the average, too poor to dig.

Analysis:[27]

Yorktown marl

Potecasi Creek ..... 33-61% calcium carbonate Trace phosphoric acid

HYDE COUNTY

Hyde County is a low plain of Pamlico Pleistocene. Scattered local lenses of shell marl should be found in the county. The Intercoastal Waterway has cut some of these shell marls near Pungo River, as shells are exposed on the spoil piles. These marls are low in lime, high in sand, and of little value as a source of lime.

JONES COUNTY

The Chowan Pleistocene terrace covers the southeastern part of the county and the Wicomico Terrace the northwestern part. Under this non-marl surficial cover, except in the western part (where the Pee Dee Cretaceous is present) the Trent Miocene marl occurs. The Trent is exposed along the Trent River and its tributaries.

At one time the Trent River Marl and Limestone Company and the North Carolina Department of Agriculture worked adjoining properties on the north side of the Trent near Scotts Creek. In 1918, they were mining some 12,000 tons of marl and limestone a year, all of which was ground. These plants have long since fallen into decay. When the Trent River Marl and Limestone Company plant was visited in 1945, the present owner was removing what was left of the railroad track for scrap, while the wood structure had almost entirely fallen in and rotted away.

At the present time (1946), the Leon Simmons' Pit, about a mile east of Pollocksville and near the river bank, is the only pit being worked in the county. It was worked off and on by prison labor for some years before 1941 as a source of aggregate for concrete. In the spring of 1946, it was leased by Mr. Hodges of New Bern and is now being operated by a dragline. Here the overburden varies from nothing to four or five feet. The top of the marl is very irregular and contains many tubular sinks full of sand or clay. The present operation consists of deepening the present pits by about 10 feet below the water level. This 10 feet is removed with a dragline and the work can go on easily as long as the marl is soft enough. It was planned to barge this marl to New Bern but, to date (August 1946), it is being trucked to New Bern and used in part for aggregate for cement blocks and part for road metal. The dragline has a one-half yard bucket and is piling marl well ahead of truck removal.

From Comfort toward the eastern county line there are numerous outcrops of Trent marl along both the north and south banks of the Trent River. They consist of exposures of marl from a few feet to 12 or 15 feet thick. Some is slightly to fairly well silicified but, for the most part, the marls will run better than 75 per cent calcium carbonate, with an overburden from zero to ten feet. These marls all have a thicker overburden as one goes away from the river and about a mile back are covered with a gray clay with a variable sand content.

A deeper covered strip of marl runs southward from near Dover into Onslow County. This has been little worked due to the heavy overburden.

Analysis: see table II

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[27] Lc. p. 99.

TABLE II
MARL AND LIMESTONE ANALYSES
JONES COUNTY

LOCALITY	$CaCO_3$	SiO_2	F_2O_3	Al_2O_3	$MgCO_3$	P_2O_3	Analyist	
Marl on Trent River	91.96	3.86	0.58	1.00	2.20		E. E. Randolph	*
Limestone near River	95.18	3.65	0.65	0.30	0.64		" " "	*
Lmestone one mile back	95.52	1.48	0.40	1.13	0.37		" " "	*
Trent River Marl & Limestone Co.	85.93						?	*
Trent River Marl & Limestone Co.	85.22					0.33	?	†
North Carolina Dept., Agriculture	87.72					0.15	?	†
John Whitford Property	72.19	26.05					?	†
Whitford Landing	78.32					0.49	?	†
Mill Creek	55-66						?	†
Foy Plantation	64.79					0.31	?	†
Flat Swamp	73.12					0.66	?	†
Comfort	88.70						?	†
Trenton	34,44 & 79%						?	†

* Economic Paper 62, N. C. Dept., Conservation & Development. The Mining Industry in North Carolina in 1926, pp. 53–54.
† Bull. 28, N. C. Dept., Conservation & Development. Limestones & Marls in North Carolina 1921, pp. 114–123.

LENOIR COUNTY

North of the Neuse River, Lenoir County is underlain by the Pee Dee Cretaceous and is more or less covered with surficial sands and clays of the Pleistocene. There are a few thin, high lime beds in the Pee Dee, but they are too thin to be of value for lime. South of the Neuse is found the Castle Hayne Eocene. The Castle Hayne is overlain by Pleistocene sands and loams often of fair thickness so as to bury the Castle Hayne under considerable overburden. However, the stream valleys often expose the Castle Hayne. On Whitely Creek, at Dave Wilkins plantation a soft and fine-grained marl analyzed 57 per cent calcium carbonate, while a sample from just above the junction of Whitely Creek and Neuse River with only a few feet of overburden analyzed 74.05 per cent. Along Mill Branch under some four feet of overburden an 80 per cent marl is reported. Some of the marls are supposed to run over 80 per cent and should be worth looking into.

Analysis:[28]

Trent Marl: Wilkins plantation Whitely Creek—57% calcium carbonate
Outlaw plantation Whitely Creek and Neuse River 74.05 calcium carbonate—0.50% phosphoric acid.
Mill Branch 80% calcium carbonate

North Carolina Department of Agriculture 70-88% calcium carbonate

MARTIN COUNTY

Martin County is underlain with Miocene Yorktown surfaced with Pamlico sands and loam of the Pleistocene. Marls are often encountered in the wells and at Williamston[29] a well encountered Yorktown Miocene with shells from 40 to 100 feet below the surface. Numerous old pits scattered through the county attest to attempts to develop the marls. There is no record of any marl being used in recent years, and it is thought these marls are rather poor in lime.

Analysis:[30]

Yorktown—Less than 30% calcium carbonate.

NEW HANOVER COUNTY

The surface of New Hanover County is covered with Pamlico and Chowan Pleistocene terraces. The Castle Hayne Eocene in the vicinity of its type locality underlies the northwest part of the county. The

[28] Lc. p. 107.
[29] Mundorff, M. J., Selected Well Logs in the Coastal Plain of North Carolina, North Carolina Dept. Cons. and Devel., Div. Min. Res. Inf. Circ. 3, p. 13, 1945.
[30] Loughlin, G. F., Berry, E. W., and Cushman, J. A., Limestones and Marls of North Carolina. North Carolina Geol. and Econ. Survey Bull. 28, p. 101, 1921.

type locality is at the old abandoned county quarry at Castle Hayne eight miles north of Wilmington. Another old quarry in the Castle Hayne is the old Wilmington City Quarry on Smith Creek. Some 12 to 15 feet of Castle Hayne were taken out, the harder layers being used for road metal and the softer for land dressing. Both these localities were worked out or abandoned some twenty years ago.

At the present time the county is working a pit about a mile west of the Castle Hayne-Wilmington Highway, just south of Prince George Creek. Most of this is used for road work.

Pamlico coquina is exposed along U. S. Highway Route 421, south of Wilmington to Carolina Beach and along the beach between Fort Fisher and Carolina Beach. Some of the harder coquina has, in the past, been used for road metal.

All of the marl in this county is rather indifferent in regard to the content of calcium carbonate which varies from 20 to 90 per cent. It does not look as if commercial production is possible.

Analysis:[31]

Castle Hayne—35%-75% calcium carbonate.

NORTHAMPTON COUNTY

Northampton County reaches elevations of about 350 feet. The surface is made up of scattered patches of Pamlico and Croatan sands and loams which here seem to be free of shells. The underlying Yorktown, which was originally deposited on the older Cretaceous, has been eroded away over much of the area but where it occurs may carry low grade shell marls. These local marls sometimes run over 35 per cent calcium carbonate. At Severn, analyses show 33.67 per cent calcium carbonate. These deposits have been used locally for land beneficiation but, at present, are not being used.

Analysis:[32]

Yorktown Marl at Severn—33.67% calcium carbonate—0.20 phosphoric acid.

ONSLOW COUNTY

Thick Pleistocene deposits cover the southern coastal part of the county, whereas for the rest of the county the Pleistocene is much thinner and Yorktown and Trent Miocene, as well as Castle Hayne Eocene, are exposed in stream valleys and ditches.

The most important locality in the county is at Belgrade. During the World War II some 8½ million to 12 million tons of this limestone were shipped for air strips and road metal in the region. Then the plant operated some 12 steam shovels. At present (August 1946) they are operating 1 shovel, 1 drag line, 12 trucks, and 2 wagon drills. The main pit is across White Oak River in Jones County, but the plant is in Onslow. At this pit there is 10 feet of sandy overburden which is removed with a small power shovel. Wagon drills put down holes about 25 feet and the lime stone is shot, in some cases the fractionation is poor and jack hammers are used to further reduce the fragments. The upper 20 feet of marl is loaded by steam shovel and trucked to the plant. Later the drag line takes out another four feet of limestone, below the floor left by the steam shovel without additional blasting. The limestone is trucked to the plant and crushed, sized, and loaded in railroad cars and trucks as needed. Some is stockpiled. Approximately three million gallons of water per day are being pumped to keep the pit dry. The material is partly Trent marl and partly Castle Hayne. The entire thickness is not being removed.

From Belgrade southward along White Oak River to below the mouth of Hunter Creek the Trent is present although not everywhere exposed.

From Richlands to Jacksonville along the New River sandy Castle Hayne marls are to be found but, as far as known, are not being used.

Analysis:[33]

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[31] Lc. p. 133.
[32] Lc. p. 98.
[33] Lc. p. 125-127.

Trent and/or Castle Hayne	*Calcium carbonate*	*Phosphoric acid*	*Analyst*
Belgrade	56.50%	4.3	F. P. Drane
Belgrade	37.62%	8.0	Mr. Henderson
Trent			
Richland	66.49%	1.15	
Richland	60.62%	12.24	B. W. Kilgore
Greenbranch	42.28%	4.61	"
Jacksonville	66.49%	1.15	"

PAMLICO COUNTY

Pamlico County is low and swampy being covered with the Pamlico Pleistocene. A very poor grade shell marl is found on ditch dumps near Olympia on the road to Reelsboro. Scattered shell fragments occur on the ditch banks near Bayboro. Shell fragments are encountered in the borrow pits near Merritt where material was removed to build roads. North of Bayboro half way to the county line in the vicinity of the burned out village of Bay City, there are numerous water filled pits which apparently were dug for marl. The marl was apparently poor and at or below the water table. There is no record of it being used and the old fields do not show shell fragments, so it is questionable if any shell marl was used. Shell marl has been reported near Oriental and from the description should be Trent but the report cannot be verified. These numerous occurrences in this county are all of such poor value that they are useless as sources of lime.

PASQUOTANK COUNTY

Pasquotank County is a low level plain of the Pamlico formation with scattered, low lime shell beds of the Pamlico formation to be expected almost anywhere in the area. At Elizabeth City a marl of 26 per cent calcium carbonate has been found. This, however, is too poor in lime to be of any value.

PENDER COUNTY

The surface of Pender County is made up of Pleistocene sands and loams which increase in thickness as one approaches the coast, except for narrow outcrops of the underlying beds along the streams. Pee Dee Cretaceous underlies the Pleistocene except in the eastern part of the county where the Castle Hayne Eocene is below the Pleistocene, and except where very thin beds of Yorktown Miocene are between the Castle Hayne and the Pleistocene.

Castle Hayne marl has been taken out at various places in a strip several miles wide along the Northeast Cape Fear from near Watha southward and below Rocky Point into New Hanover County, the largest pits being on the farm of Mr. Hugh MacRae east of Rocky Point. In this area the Castle Hayne is exposed as low ridges in the fields and has very little overburden (0-5 feet). The plant that was in operation in 1918 is still standing although it has not been used for some years. From examination of some of the material around the mill, it appears that a thin lens of Trent is on top of the Castle Hayne at this place. Mr. MacRae has shown considerable interest in giving some two million tons of Castle Hayne to the State if they will remove it for agricultural uses. Analyses show slightly over 89 per cent calcium carbonate. Although not on the river or railroad, these marls could well be trucked to the "black lands" lying along the Atlantic Coast Line Railroad.

Some possible Pleistocene marls were dug 25 years or more ago along the Atlantic Coast Line Railroad near Woodside. The marls were poor grade.

Analysis:[34]

[34] Lc. pp. 129-131.

Castle Hayne							
H. MacRae Plant	$CaCO_3$	SiO_2	$CaSO_4$	$FeAlPO_4$	NaCl	Indef	Law & Company
	89.47	5.52	1.23	2.34	0.20	0.22	Wilmington
				P_2O_5			
	87.57			0.56			
Rocky Point	88.91						
	87.16						
Nixon House	25.75 (CaO)	51.45		0.38			F. P. Drane
Rocky Point	45-92						
	55.00			16.42			

PERQUIMANS COUNTY

Perquimans County is a low level plain of Pamlico formation except along the western edge where the Chowan formation makes higher ground. Here the Pamlico contains scattered lenses of shell marl, but it is too limited in extent and too poor in lime to be be of any value.

PITT COUNTY

The gently rolling surface of Pitt County rises from near sea level along the principal streams to about 120 feet near the western border. The surface is in general sands and loams of the Pleistocene. Miocene Yorktown underlies the Pleistocene and is in turn underlain by Cretaceous which outcrops along the Neuse and Tar Rivers and Big and Little Contentnea Creeks. Shell marls are widely distributed and range in depth from the surface to 50 or 65 feet and are Yorktown Miocene in age.

No marl has been dug in the northwest part of the county in 25 or 30 years, but some was dug within the last year (1945) on the Greene Place between Grifton and the Craven County line.

ROBESON COUNTY

The Pleistocene sands and loams cover most if not all the surface of this county and for the most part are underlain by non-calcareous Cretaceous, although here and there on this Cretaceous and under the Pleistocene are isolated patches of low calcium Yorktown Miocene, and occasionally some Waccamaw (Pliocene) marl.

In the past the Yorktown and Waccamaw marls were used on the land, but there has been no production for at least a decade.

Analysis:[35]

Yorktown.....Less than 50% calcium carbonate.

SAMPSON COUNTY

Pleistocene sands and loams cover the entire county and except for a narrow strip along the eastern margin of the county they are underlain for the most part by the Black Creek Cretaceous. The Castle Hayne Eocene underlies the eastern margin. On top of both the Black Creek and the Castle Hayne there may be local remnants of the Yorktown and Trent Miocene. Various reports give past digging of marl from Great Coharie Creek eastward to Turkey, but there has been little or no marl dug during the last 50 years.

Analysis:[36]

Yorktown	Calcium carbonate	Phosphoric acid
Yorktown	40-50%	0.70%-1.50%
Newton Grove	55.86%	
Trent		
Harrell's Store	75.69%	

[35] Lc. p. 128.
[36] Lc. p. 127.

TYRRELL COUNTY

Tyrrell County is a low plain of Pamlico formation. Local and poor grade shell marls of the Pamlico should occur scattered in the area, but they are thought to be of little importance.

WASHINGTON COUNTY

Washington County is low and largely covered with Pamlico Pleistocene. Here the scattered local and poor shell marls of the Pamlico should be found. However, as they are so poor and limited, they are of little value.

WAYNE COUNTY

Wayne County ranges in elevation from about 70 feet to 190 feet above sea level and the surface is fairly well dissected. In the western part of the county the non-calcareous slates occur. Resting on these are non-calcareous Cretaceous beds. In the southeast part of the county there is some scattered Castle Hayne Eocene, as well as a few isolated patches of Trent Miocene and a single patch of Yorktown Miocene. All these various formations are more or less masked under Pleistocene sand, gravels, and loams. Various attempts to work marl around Mount Olive have been made in the past, but none are known to be working at present. There is marl in both the Castle Hayne and Trent. They both may be locally high in lime, the Trent being the better of the two.

Analysis:[37]

Trent Marls	40-83% calcium carbonate	Average 70%

WILSON COUNTY

Wilson County is reasonably level and covered with sands and loams of the Pleistocene. The western half of the county is underlain by Cretaceous beds entirely without marls. In the eastern half of the county on top of the Cretaceous, but usually covered by Pleistocene, are scattered patches of Yorktown Miocene. The Yorktown contains scattered layers of marl. Marls have been dug, in the past, near Wilson on Toisnot Creek, Hominy Creek, along White Oak swamp, and near Sharpsburg. Analyses mentioned in Bulletin No. 28 give the range of calcium carbonate from 38 to 72 per cent. Where the marls run over 50 per cent and are easily available, they might be used locally in spite of their limited extent.

Analysis:[38]

Yorktown	38-72% calcium carbonate	0-4½% phosphoric acid

[37] Lc. pp. 106-107.
[38] Lc. p. 102.

DATE DUE

APR - 5 1968			